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I translated a certified copy of the priority document of Korean Patent Application No. 2002-80116, filed December 16, 2002 in Korea.

I hereby state that the English translation is true and accurate, and further that this translation was made with the knowledge.

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[ABSTRACT OF THE DISCLOSURE]

A filter characteristic measuring method and system capable of measuring a gain of an analog filter adapted in a DUT(Device Under Test) and a frequency response at a high speed, wherein the filter characteristic measuring method includes the steps of generating an impulse signal, applying the impulse signal to the DUT having an analog filter through a digital channel, and measuring a gain of the analog filter built-in the DUT and a frequency characteristic by using an output of the analog filter.

[REPRESENTATIVE DRAWING]

Fig. 2

[SPEICIFICATION]

[TITLE OF THE INVENTION]

FILTER CHARACTERISTIC MEASURING METHOD AND SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of preferred embodiments of the invention with reference to the drawings, in which:

FIG. 1 is a block diagram of a general test system to measure a characteristic of an analog filter;

FIG. 2 is a block diagram of a filter characteristic measuring system according to an exemplary embodiment of the present invention; and

FIGS. 3 to 6 show waveforms of signals related to FIG. 2.

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND PRIOR ART IN THE FIELD]

The present invention relates to a test field of measuring a characteristic of a filter employed in a DUT(Device Under Test). More specifically, the invention relates to a filter characteristic measuring method and system for measuring a gain of an analog filter and a frequency response at a high speed.

A DUT, e.g., a signal conversion system, internally employs an analog filter such as an equalizing filter etc. Such a DUT is tested through a typical automatic test device in a test procedure or for a product test. At this time, a characteristic of filter, e.g., a boosting gain and a frequency response are measured according to variously required necessities.

FIG. 1 is a block diagram of a conventional simple automatic test device.

Referring to FIG. 1, the conventional automatic test device includes a sine wave oscillator 1, an analog filter 2

and an alternate current(AC) voltmeter 3. The sine wave oscillator 1 generates a sine wave that oscillates as a variably determined frequency in a determined frequency band. The sine wave is applied to the analog filter 2 of the DUT and a line LI1. A switch SW connects one of an output line LI2 of the analog filter 2 and the line LI1 to an input terminal of the AC voltmeter 3. The AC voltmeter 3 selectively receives any one of outputs from the analog filter 2 and the sine wave oscillator 1 to be tested. The AC voltmeter 3 measures an output voltage of the analog filter 2 when the switch SW is connected to the output line LI2, or directly measures an output voltage of the sine wave oscillator 1 when the switch SW is connected to the line LI1. In such a frequency sweep method, a gain of the analog filter for a sine wave per each objective frequency is obtained through the AC voltmeter 3, that is, the filter characteristic is measured.

However, such a conventional testing method must be passed through the frequency sweep in order to generate sine waves having respectively different frequency in a determined frequency band, and whenever that, an output amplitude must be also measured through the AC voltmeter. Thus, a measuring time is lengthened, and further in an actual mass-production, such a measurement can be performed only for several frequencies in a frequency band of interest, that is, it is difficult to overall exactly measure a characteristic of an equalizing

filter.

[SUMMARY OF THE INVENTION]

Accordingly, it is an object of the present invention to provide a filter characteristic measuring method and system in which a gain of an analog filter employed in a DUT(Device Under Test) and a frequency response are measured at a high speed, a time taken in measuring the gain of the analog filter and the frequency response is remarkably shortened, and an output response is measured at a high speed by applying an impulse signal to the DUT including an equalizing filter.

In order to achieve the above objects, according to one aspect of the present invention, a filter characteristic measuring method comprises the steps of generating an impulse signal; applying the impulse signal to a DUT having an analog filter through a digital channel; and measuring a gain of the analog filter built-in the DUT and a frequency characteristic by using an output of the analog filter.

In accordance with another aspect of the present invention, a filter characteristic measuring system in a DUT employing an analog filter comprises a digital channel for providing an impulse signal to the analog filter; a digitizer for receiving an output signal of the analog filter so as to measure a characteristic of the filter; and a controller for controlling the digital channel and the digitizer.

As a result, a gain of an analog filter employed in a DUT and a frequency response can be measured at a high speed.

[EMBODIMENTS OF THE INVENTION]

Hereinafter, preferred embodiments of the present invention are explained in detail with reference to the accompanying drawings FIG.2 through 6.

FIG. 2 is a block diagram of a filter characteristic measuring system according to an exemplary embodiment of the present invention.

Referring to FIG. 2 that shows a DUT(Device Under Test) 20 and a filter characteristic measuring device 100, an impulse signal provided from the filter characteristic measuring device 100 is applied to an input line L1 of the DUT 20 in which an equalizing filter 10 is built therein. The filter characteristic measuring device 100 is largely divided into a digital channel 40, a controller 30 and a digitizer 50.

The digital channel 40 includes a comparator 42 for generating an impulse signal as shown in FIG. 3.

The digitizer 50 includes an anti-aliasing filter 52 for antialiasing-filtering a filter output received through an output line L2 of the DUT 20; an analog to digital(A/D) converter 54 for converting the filter output outputted from the anti-aliasing filter 52 into digital data; a memory 56 for capturing the digital data outputted from the A/D converter 54

at a determined storage region; a digital signal processing (DSP) 58 for processing in signal the digital data captured at the memory 56 by a command of the controller 30; and a digital filter 59 for receiving the process signal outputted from the DSP 58 and digitally filtering the process signal.

The filter characteristic measuring device 100 to measure a frequency response characteristic of the equalizing filter 10 applies an impulse signal to the DUT 20 as a specific object by using a digital channel, and analyzes an output waveform outputted from the equalizing filter 10, through the digitizer 50.

Synchronization between an output of the impulse signal and an input of an output signal outputted from the filter is performed by the controller 30. The controller 30 can be embodied by a microprocessor having a test program. An operation of an output response of the filter as the tested object can be performed by the DSP 58 according to a command of the controller 30. The DSP 58 moves the output data stored in the memory 56 to an internally operational-use buffer, and then performs differential and fast Fourier transform (FFT) operations by using a digital signal process algorithm. An output of the DSP 58 is applied to the digital filter 59 and is filtered digitally, to thus eliminate a high frequency component contained into the output of the DSP 58.

FIGS. 3 through 6 represent waveform drawings of the

signals related to FIG. 2, where FIG. 3 illustrates a waveform of an impulse signal outputted from the comparator 42.

In FIG. 3, a transverse axis indicates a time and a perpendicular axis indicates a voltage V. The impulse signal has a theoretically unlimited height and a width of '0', thus can be represented as a function of an area '1'. When this function is represented as a frequency domain through the FFT, all frequency components have a unit size of a '1'. Therefore, applying the impulse signal to some device has the same meaning as simultaneously applying sine waves of all frequency to the device. The present invention started from such a point. But, actually, only an approximate impulse signal having a limited size and some width is generable.

In case the impulse signal is applied through a digital channel, carelessness is required so that a signal applied to the DUT is approximate to an ideal impulse signal. In order that the impulse signal is approximate to the ideal signal, a rise time of the impulse signal must be very quick as compared to a response time of the DUT. In case the signal approximate to the ideal impulse signal is applied, power is uniformly provided to all frequency components within a measurement frequency band of the DUT as the tested object. Meanwhile, in case an amplitude (height) of the impulse signal is too small, power supplied to a tested object is too weak thus an output is not performed well, thus the measurement is difficult.

Therefore, to obtain a measurable output signal of enough amplitude, the impulse signal having enough amplitude must be applied to the DUT.

FIG. 4 illustrates an output waveform of the equalizing filter 10 obtained through the anti-aliasing filter 52 of the digitizer 50.

Referring to FIG. 4, a transverse axis indicates a frequency and a perpendicular axis represents a voltage. An impulse signal like FIG. 3 is provided to the equalizing filter 10, then an output from the equalizing filter 10 is provided as a real waveform, to thus obtain the output waveform shown in FIG. 4.

FIG. 5 depicts a filtering characteristic of a digital filter, as an example of a digital filter of about 500 kHz.

FIG. 6 sets forth waveforms respectively provided in input and output terminals of the digital filter of FIG. 5.

In FIG. 6, an input signal UB before use of the digital filter 59 is obtained by converting an output waveform of FIG. 4 into digital data, then by differentiating the digital data to gain an impulse response, and then by performing a conversion into an output power spectrum through the FFT operation. Further, an output signal UA after use of the digital filter is obtained by removing a high frequency component through the digital filter. An output signal filtered through the digital filter is easy for use of a

measurement for maximum frequency response and gain.

According to an observation of the present inventor, when a characteristic of an equalizing filter of 'S5L1462B' adapted as a measuring-use device was measured by a conventional measuring method, it took about 0.5 second, meanwhile when the characteristic was measured by using an impulse signal based on the present invention, it took about 0.05 second. As a result, in the measuring method based on the embodiment of the present invention for measuring the filter characteristic by applying an impulse signal to the filter, the frequency characteristic over the whole region of a frequency band of interest can be measured in a quick time, thus a test time is reduced remarkably. That is, in the present invention, a test time can be shortened over 10 times as compared to the conventional frequency sweep method as a general analog filter testing method.

When this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made herein without departing from the spirit and scope of the invention as defined by the appended claims.

[EFFECT OF THE INVENTION]

As described above, the filter characteristic measuring

method of the present invention has an effect of measuring a gain of an analog filter and a frequency response at a high speed.

[CLAIMS]

1. A filter characteristic measuring method, comprising the steps of:

generating an impulse signal;

applying the impulse signal to a DUT(Device Under Test) having an analog filter through a digital channel; and

measuring a gain of the analog filter built-in the DUT and a frequency characteristic by using an output of the analog filter.

2. The method of claim 1, wherein the analog filter is an equalizing filter.

3. An analog filter characteristic measuring method, characterized in that an impulse signal is applied to an equalizing filter by using a digital channel of an automatic tester, and then an output response of the equalizing filter is obtained and a differential and a fast Fourier transform (FFT) operation therefor are performed so as to measure a boosting gain and a frequency response.

4. A system for measuring a characteristic of a filter in a DUT employing an analog filter, said system comprising:

a digital channel for providing an impulse signal without applying a sign wave to the analog filter;

a digitizer for receiving an output signal of the analog filter so as to measure the characteristic of the filter; and

a controller for controlling the digital channel and the digitizer.

5. The system of claim 4, wherein the digitizer comprises:

an anti-aliasing filter for antialiasing-filtering an output of the filter;

an analog to digital (A/D) converter for converting a filter output outputted from the anti-aliasing filter into digital data;

a memory for capturing the digital data outputted from the A/D converter at a determined storage region;

a digital signal processing (DSP) for processing in signal the digital data captured at the memory; and

a digital filter for receiving the process signal outputted from the DSP and digitally filtering the process signal.

6. The system of claim 4, wherein the analog filter is an equalizing filter.